Building the Foundations of an Informatics Agenda for Global Health - 2011 Workshop Report

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Abstract

Strengthening the capacity of public health systems to protect and promote the health of the global population continues to be essential in an increasingly connected world. Informatics practices and principles can play an important role for improving global health response capacity. A critical step is to develop an informatics agenda for global health so that efforts can be prioritized and important global health issues addressed. With the aim of building a foundation for this agenda, the authors developed a workshop to examine the evidence in this domain, recognize the gaps, and document evidence-based recommendations. On 21 August 2011, at the 2011 Public Health Informatics Conference in Atlanta, GA, USA, a four-hour interactive workshop was conducted with 85 participants from 15 countries representing governmental organizations, private sector companies, academia, and non-governmental organizations.

The workshop discussion followed an agenda of a plenary session - planning and agenda setting - and four tracks: Policy and governance; knowledge management, collaborative networks and global partnerships; capacity building; and globally reusable resources: metrics, tools, processes, templates, and digital assets. Track discussions examined the evidence base and the participants' experience to gather information about the current status, compelling and potential benefits, challenges, barriers, and gaps for global health informatics as well as document opportunities and recommendations.

This report provides a summary of the discussions and key recommendations as a first step towards building an informatics agenda for global health. Attention to the identified topics

and issues is expected to lead to measurable improvements in health equity, health outcomes, and impacts on population health. We propose the workshop report be used as a foundation for the development of the full agenda and a detailed roadmap for global health informatics activities based on further contribution from key stakeholders. The global health informatics agenda and roadmap can provide guidance to countries for developing and enhancing their individual and regional agendas.

Key words: Global Public Health Informatics, Agenda, Policy, Capacity Development, Collaboration

Introduction

In today's globalized world, where diseases, conditions or events affecting health transcend national boundaries,(1) the need to strengthen the capacity (2) to protect and promote the health of the global population continues to be important. The application of Information and Communication Technology (ICT) for health i.e. eHealth (3) is an important aspect of the delivery of global health.(4) Leveraging informatics best practices and principles is essential for improving global health response capacity through implementation of eHealth.(5) A critical step towards strengthening this capacity is developing an informatics agenda for global health which can provide guidance to countries for developing and enhancing their national and regional country agendas. The 2005 58th World Health Assembly eHealth Resolution (WHA58.28) urges Member States "to consider drawing up a long-term strategic plan for developing and implementing eHealth services."(6) Since then, two significant collaborative activities have addressed WHA58.28: a. Initial high-level efforts at Bellagio 2008 led to an "eHealth Call to Action"(7); and b. Mahidol Global Health Information Forum 2010 convened informatics experts,(2) resulting in a "Call to Action" agreeing to general eHealth principles.

In an effort to continue to address WHA58.28, the authors identified the need for an activity to examine the evidence for use of informatics for global health, recognize the gaps in evidence, and provide evidence-based recommendations as the next logical steps toward building a comprehensive informatics agenda for global health. To ensure perspective diversity and stakeholder involvement, a group of 85 invited experts representing a diverse stakeholder community gathered for the Global Health Workshop at the 2011 Public Health Informatics Conference on 21 August 2011 in Atlanta, GA, USA.

The workshop goals were to begin building an informatics agenda addressing current and future global health challenges,(8) and to support the implementation of eHealth initiatives using informatics principles and practices to improve global health. Workshop objectives included:

1. Engage health informatics and global health experts to discuss the foundational elements of an informatics agenda for global health.

2. Identify informatics evidence-base, best practices and principles to draft key elements of the agenda for global health.

3. Define global health challenges and priorities, and formulate next steps to move towards the full agenda.

The full scope of topics from the 2008 Bellagio Call for Action (7) was reorganized into tracks according to topic affiliation to structure expert dialog on key areas described below.

Plenary Session: Planning and Agenda Setting:

The plenary session engaged all participants together to discuss global health challenges that implementation of informatics scientific principles and practice can address, thus setting the stage for the subsequent track discussions.

Track 1 - Policy and Governance:

Supportive policy and governance development and implementation are essential to successful implementation of eHealth and thus are important to include in informatics agendas.(9) Political authorities, policymakers and stakeholders must take collective action for consensus-based use of institutional resources. Formation of councils, creation of eHealth policy frameworks, toolkits and a trained workforce are key elements for policy and governance development and implementation.

Track 2 - Knowledge Management, Collaboration, and Global Partnerships:

Collaboration is a fundamental success factor for global health—it supports the use of "the resources, knowledge, and experience of diverse societies to address health challenges throughout the world."(1) The implementation of relevant informatics best practices support collaboration and knowledge management among the eHealth stakeholders. Multisectoral collaboration has been recommended by WHA58.28 for addressing global health needs.(6)

Track 3 - Capacity Building:

Capacity building efforts occur at the individual, institutional, and societal levels. These efforts support the development of in-country expertise to build infrastructure and harness resources, bolstering capabilities and economic value. The scope of this track encompassed informatics training and education in diverse domains including leadership and management. Participants also discussed mechanisms to support country-level initiatives and foster country ownership to ensure sustainability of eHealth efforts, and capacity building in data management.

Track 4 - Globally Reusable Resources: Metrics, Tools, Processes, Templates and Digital Assets:

eHealth resources that can be shared and reused via various models facilitate the development of scalable and sustainable infrastructures and institutes essential to the effectiveness and productivity of a health enterprise. Examples of successful models include: metrics – Health Metrics Network (HMN) framework; tools – free and open source software, Virtual Data Toolkit

(VDT); processes – monitoring and evaluation processes; templates – for standard operating procedures; and digital assets – digital libraries.(10)

Methods

Invitations to participate in the workshop were sent to public health informatics and global health experts identified through purposive sampling (i.e., snowball sampling). Workshop registration link was also provided on the conference website for open enrollment. Registrants were asked to indicate their track of interest during online registration. The registration lists were reviewed and shortlisted because of limited seating capacity; best efforts were made to include stakeholders from all represented groups in each track. Each track was supported by the track lead and invited experts. To facilitate discussion some of the larger tracks broke into smaller discussion groups. Each track used the following predefined discussion format:

1. Set the stage: Why is this area of informatics important?
2. Current status: Where are we today?
3. Compelling benefits: What are the established and potential outcomes?
4. Challenges, barriers and gaps: What are the hurdles on the way towards our goals?
5. Opportunities and recommendations: What are the opportunities and where do we aim to be tomorrow?

Results

The workshop was organized as an ancillary meeting in the pre-conference session of the 2011 Public Health Informatics Conference, Atlanta, GA, USA. There were 85 participants from 15 countries representing governmental organizations, private sector companies, academia, and non-governmental organizations. The following summaries—organized by track and following the dialog format methodology—represent the key outcomes of the workshop discussions. Additional information is provided in exhibits.

Plenary Session: Planning and Agenda Setting

The workshop co-chairs led the plenary track and recognized that regular reassessment of the rapidly changing state of ICT, eHealth initiatives, and informatics practices and principles can provide evidence to develop and continually strengthen a robust informatics agenda, implementation of which could move the eHealth activities forward more systematically. However, to set an agenda, a clear definition of global health is essential. Global health as a term is found in literature but there is no consensus on definition. (1, 11-13) The scope of global health as defined by Koplan et al (1) was used as a reference to define the scope of this agenda-setting workshop.

Health information systems development to provide quality data and information to make better health-related decisions is crucial for supporting global health goals. Enterprise architecture is a methodology that assists in systematically organizing the multiple elements in the design and development of health information systems and ICT infrastructure to meet global health equity and health impact goals. Global health equity requires focusing on both domestic health disparities and cross-border concerns. (1) Health impact assessment requires well-defined

measures to assess population health improvement due to the implementation of ICT through eHealth initiatives using informatics practices and principles to guide implementation. A fuller discussion of how global health enterprise architecture could be developed, implemented, and evaluated was identified to be beyond the scope of this workshop and recommended as the topic of a future workshop.

Track 1: Policy and Governance

Set the Stage

Many nations have some form of eHealth policy, but commonality remains limited. Policymakers face numerous challenges in thinking beyond local representation needs in a global context.(3) The potential of eHealth to meet both national and global health objectives has not been fully developed and requires strong leadership.(14)

Current Status

Global eHealth policy and governance development and implementation is an iterative and ongoing process. Enormous advances have been made in medical knowledge, technology, and training of health care professionals, but eHealth application based on standard methodologies is significantly lagging because of policy gaps. Policymakers generally react to specific problems and crises leading to gaps in the overall national and global polices. Nations around the world struggle to effect eHealth policy models that can build on evidence-based practices and measures. Some sporadic, focused efforts have occurred before and since the meeting in Bellagio 2008 (Exhibit 1). However, to date, no global, sustained collaborative effort has been established towards developing global eHealth policy and governance guidelines. Collaborative investments in global policy and governance development are needed to usher in the promise of eHealth.(15)

Exhibit 1. Key recent eHealth policy and agenda setting activities

- The 2005 58th World Health Assembly eHealth Resolution (WHA58.28) urged Member States to consider developing long-term strategic plans for developing and implementing eHealth services. The World Health Organization (WHO) Global Observatory for eHealth (GOe) supports these goals by providing Member States with strategic information and guidance on effective practices, policies, and standards in eHealth.[a]
- Leadership Series Forums on Health Information Systems (HIS) have convened in several WHO regions. [b]
- The Health Metrics Network (HMN), established in 2005, is the first global partnership dedicated to strengthening national health information systems. HMN operates as a network of global, regional, and country partners. Among HMN's initiatives, a target of having accurate, real-time data from the vital registration systems in all countries by 2020 was proposed in September 2011 by Thomas Frieden, Director of the U.S. Centers for Disease Control and Prevention.[c]
- The "Making the eHealth Connection" effort, led by the Rockefeller Foundation, in coordination with internationally recognized conveners in the fields of global health, international development, and information and communications technology (ICT), resulted in the 2008 Bellagio Meeting.[d]

- The mHealth Alliance (mHA) was formed in 2009 to advance mobile health through policy, research, advocacy, and support for the development of interoperable solutions and sustainable deployment models. [e]
- The International Organization for Standardization (ISO) eHealth standards (in draft) contains eHealth architecture and capacity-building standards. Public Health Task Force, a working group hosted by the ISO/Technical Committee (TC) 215 "Joint Initiative on Standards Development Organization (SDO) Global Health Informatics Standardization", drafts the standards. [f]
- European countries have made substantial progress toward modern eHealth infrastructures and implementations, thereby leading the rest of the world. The European Union (EU), comprising 27 countries of differing economic levels that share a vision of health care developed in the 2004 eHealth Action Plan, called on Member States to develop an eHealth roadmap to 2010. Annually, the EU convenes eHealth conferences, meetings of Ministers of Health, and holds initiatives on interoperability, quality criteria, and lead markets.[g]

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[a] Fifty-eighth World Health Assembly, Resolution twenty eight, 16-24 May 2005, Geneva, Switzerland. WHA58-28 on eHealth. [accessed 9 October 2011]; Available from: http://apps.who.int/gb/ebwha/pdf_files/WHA58/WHA58_28-en.pdf and http://www.docstoc.com/docs/101599959/Resolution-WHA5828-eHealth---WHO--World-Health-Organization

b HIS Forum. Webpage on the Internet. [accessed 21 February 2012] Available from: http://hisforum.org/

c Health Metrics Network (HMN). Webpage on the Internet. [accessed 21 February 2012] Available from: http://www.who.int/healthmetrics/en/

d Khoja S, Durrani H, Fahim A. Scope of policy issues for e-health: results from a structured review [Internet]. New York: Rockefeller Foundation [accessed 15 Jan 2010]; Available from: http://www.ehealth-connection.org/files/conf-materials/Scope%20of%20Policy%20Issues%20for%20eHealth_0.pdf

e Mobilizing Innovation for Global Health, UN Foundation. mHealth Alliance. [accessed 20 October 2011]; Available from http://www.mhealthalliance.org/

f The Joint Initiative on SDO Global Health Informatics Standardization. Global Health Informatics Standards. [accessed 20 October 2011]; Available from: http://www.global-e-health-standards.org/

g Mars M, Scott R. Global E-Health Policy: A Work In Progress. Health Aff (Millwood) 2010;29(2):239-45.

Compelling Benefits

Health in all countries could benefit from the development of a coordinated global eHealth policy to support national legislation development for effective use of eHealth resources.

Challenges, Barriers and Gaps

A unified voice for eHealth policy development is absent.(16) Often, Ministries of Health do not fully understand the benefits that eHealth can bring to national public health programs. Numerous fragmented pilot efforts continue to reinvent the wheel and consume resources.

Informatics tools to guide on-the-ground baseline assessment, implementation, scaling, and evaluation of information systems are needed, using substantial resources already in existence such as the HMN tools.(9) Exhibit 2 summarizes the Track 1 discussion. (Exhibit 2)

Exhibit 2. Summary of Policy and Governance Track

Compelling Benefits

- Informed, globally coordinated decision making and thus enhanced global health response capacity.
- Improved availability of quality information to national policy developers.
- Improved health care service quality through eHealth implementation based on informatics standards and best practices.

Challenges, Barriers and Gaps

- Lack of a globally coordinated effort for eHealth strategic planning.
- Lack of evidence-based practices for eHealth policy and governance guidelines.
- Limited and inadequate funding for development of global eHealth policy and governance strategic roadmap.
- Limited experience in technology and resistance to change.
- Changing national priorities and cultural challenges are not generally addressed in existing eHealth policy and governance material.

Recommendations

- Engage stakeholders, including Ministry of Health (MoH) officials, and provide information and resources for assessments and evaluations.
- Develop national and global research programs to identify information needs, recognize barriers to access, and translate and use information to evaluate the impact of information and knowledge-sharing interventions on health outcomes.
- Target donor funding and involvement, encourage adoption of open source platforms and of technologies focused on sustainability.
- Align donor funding to reduce global health fragmentation, harmonize reporting requirements, and consolidate reporting structures.
- Train local public health leadership in informatics, thus building capacity at country level.
- Provide tools and resources to encourage governments to adopt a culture of eHealth interoperability based on open standards.
- Encourage MoH-appointed leadership for health information technology to establish country-level agendas, and obtain stakeholder buy-in and funding.
- Encourage governments to adopt a culture of eHealth interoperability in Health System Strengthening programs, and strengthen the capacity to access and use health information as evidence to improve decision making.
- Encourage adoption of regional and cross-border information sharing, knowledge management and collaboration, and creation of virtual communities of practice and centers of excellence that lead to expanded knowledge in the use of new and existing technologies.

Opportunities and Recommendations

Bringing organizations together, building consensus, and developing a roadmap are complex propositions that present great opportunities and challenges and require momentum.(17) A logical next step would be to build a collaborative environment for convening sustainable effort. Track participants developed a 5-year national eHealth framework approach that could be used to lay the foundations for national policy development efforts (Exhibit 3).

Exhibit 3. Recommendation: Country-level 5-year eHealth policy framework

1–3 year country-specific action items

a. Engage and inform stakeholders at all levels about the need and value for timely and reliable health information.
b. Assess country health profile, and document donor health information activity profile.
c. Conduct inventory of legislation to identify policy gaps at all levels.
d. Establish policy-based coordination mechanism to institutionalize and operationalize health information use for evidence-based decision making.
e. Throughout, hold meetings and disseminate information gathered through a collaborative community.

3–5 year country-specific action items

a. Finance health information systems capacity development at all levels.
b. Establish governing mechanism to implement appropriate standards-based information systems at all levels through Standards Development Organizations (SDOs).
c. Harmonize and align legislation to comply with national obligations for reporting of health data to support global public health needs.

Track 2: Knowledge Management, Collaboration and Global Partnerships

Setting the Stage

Collaboration among diverse stakeholders to share knowledge and expertise is a fundamental factor for public health practice. Knowledge management systems are critical tools to bring people, processes, information, and technology together. A 2005 Association of State and Territorial Health Officials (ASTHO) report provided perspectives for public health knowledge management,(18) and Liebowitz has summarized selected international efforts in this domain.(19)

Current Status

Overall, there is an increasing trend in the application of knowledge management and collaboration principles and methods to the health enterprise to develop sustainable global partnerships. However, there have been few implementations that are inclusive of low-resource settings. Some eHealth specialties, such as mobile health (mHealth),(20) extensively leverage collaborative methodologies and knowledge management practices; however, eHealth in general

has not yet widely adopted these informatics best practices. Additionally, training and practice in these domains are still quite limited in the global health setting.

Compelling Benefits

The participants highlighted existing knowledge management systems and collaborative methodologies, and recognized that Web 2.0 applications and mobile technologies (21) have provided tremendous opportunities for knowledge sharing and collaboration. Experience has demonstrated that collaborating to share data, information and knowledge empowers us to increase transparency, improve research and education, support better decision making, help deliver care, and save lives.(22)

Challenges, Barriers and Gaps

Many public health information systems are functionally isolated from other systems because they are not based on informatics standards nor on sustainment models. Planning generally lacks collaboration and systems thinking; therefore, systems are not interoperable. Additionally, collaborative projects across multiple governments and organizations face policy and sociocultural barriers, in addition to lack of resources and skills, that are often bigger than technical challenges.

Opportunities and Recommendations

Resources need to be better coordinated at all levels to optimize efficiency and efficacy. Collaborative projects should be encouraged to use international informatics standards and promote free access to international standards, thus enabling interoperability, while sharing innovation and best practices. Formation of a working group to facilitate the development of the domain of global public health knowledge management and collaboration is necessary to identify strategic goals, align priorities among stakeholders, create an inventory of standards, and promote sharing of best practices. (Exhibit 4)

Exhibit 4: Summary of Knowledge Management, Collaboration and Global Partnerships Track

Compelling Benefits

- Increased transparency
- Improved health research, education and care delivery
- Enhanced public health essential practice

Challenges, Barriers and Gaps

- Information systems planning efforts lack collaboration and use of standards.
- Information system implementation lacks use of standards and best practices.
- Data collection systems generally do not collect metadata and spatial information and thus collaboration for using the data is challenging.
- Insufficient funding for education and workforce training in the domain.
- Policy, sociocultural, and technical barriers in collaboration agreements.
- Disease specific funding streams are generally not conducive to collaboration across diseases and funding streams.

Recommendations

- **Better coordinate the funding sources:** Include knowledge management and collaboration in the planning phases of projects.
- **Leverage international standards:** Promote free access to international standards to improve interoperability and thus promote collaboration around using data.
- **Form a Working Group to build a collaborative community:** The goals of the working group could be to **i**dentify strategic goals and priorities for global health informatics, and create an inventory of informatics standards, knowledge and best practices.

Track 3: Capacity Building

Set the Stage

Strengthening informatics workforce capacity positively affects public health by promoting quality of care and increasing the ability to monitor health trends. Sustainable changes require long-term planning and investment. Global health spending currently exhibits a trend toward long-term programmatic commitment, which suggests that a stable level of funding for global health initiatives will exist in the long-term. (23) Sustainable national informatics capacity will ensure continuity of informatics applications, which will promote continued improved outcomes when external funding eventually expires.

Current Status

Externally funded development initiatives provide support to resource-constrained countries, offering immediate relief for pressing health concerns. However, such efforts rarely include a strategic plan for creating long-term change in local information management infrastructure and workforce capacity.

Compelling Benefits

A robust informatics workforce supports local care delivery and public health practice. A strong local workforce provides independence from external funding and supports expertise for information management activities over the long term.

Challenges, Barriers and Gaps

Local informatics capacity building is limited in several ways. Stakeholders with varying priorities provide funding to health-promoting programs.(24) However, strategies to develop in-country information management capacity are not typically a focus of these programs. When informatics is included as a fundable activity in such programs, the goal is to provide local systems for the life of a project instead of developing capacity that will serve future efforts as well. Lack of informatics training is a major barrier to ICT implementation in resource-constrained environments.(25) Training programs, when present as part of an externally-funded program, are often focused on the use of a specific system for a finite purpose instead of basic computer literacy and information management principles. As a result, learners are rushed into information system usage without acquiring foundational skills. As there are few professional paths for health informaticians in these settings, there is little incentive for local technology talent to seek work in public health programs.

Opportunities and Recommendations

The participants advocated in-country health programs should create actionable plans to bolster local informatics capacity. Externally funded programs should contribute to local capacity while concurrently fulfilling their health intervention missions. A neutral entity must develop a framework for local informatics capacity building. The framework should build off of existing efforts to standardize capacity development,(15) and focus on sharing core training materials and curricula. Adherence to standards for capacity development should be an integral part of every public health intervention and include building off of local innovations to support viable economic development, fostering government ownership to enable eHealth benefits and knowledge transfer through portable accreditation programs. (Exhibit 5)

Exhibit 5: Summary of Capacity Building Track

Compelling Benefits

- Improved quality of care
- Improved communication
- Sustainability

Challenges, Barriers and Gaps

- Training deficits are not well studied and documented
- Strategic plans are dedicated to health issues, and often do not have informatics components
- Commercial markets do not exist for global health informatics products

Recommendations

To develop a framework for capacity building that includes the following components:

- **Building off of local innovation**: Capacity building initiatives should support the creation of viable commercial markets for health informatics products, to support sustainability.
- **Foster local government ownership and buy-in for informatics training initiatives:** Ministries of Health should be provided with tangible examples of the value of informatics for implementation of eHealth when advocating for eHealth.
- **Portable accreditation:** To allow workers to easily apply their knowledge to new environments.

Track 4: Globally Reusable Resources: Metrics, Tools, Processes, Templates, and Digital Assets

Set the Stage

In today's resource-constrained global economy, globally reusable resources are useful for developing sustainable eHealth infrastructures and systems essential to a health enterprise. Their use allows the development of community solutions, professional networks for data sharing, and open access to health information.(26, 27) Existing evidence indicates that dedication to developing globally reusable resources can lead to production of agile, efficient health systems, which can result in timely and more accurate responses to public health events.(28-30)

Current Status

Many standards-based free and open source software (FOSS) products, especially m-Health applications, are available online.(31) A number of these open source applications have achieved worldwide impact—notably, the Linux operating system and the Apache web server, which dominate the market. However, FOSS business models vary and may not always work across a global context. Additionally, total cost of ownership involving FOSS components must account for implementation and operational support as well as software update costs. The incentive model for private-sector companies must be modified to support reuse of ICT resources. Capacity building of the workforce should not be underestimated; standardized tools find success primarily through user adoption. Most mainstream public health information systems are not yet

developed with reusable resources. In the health care domain, VistA — based on open source components — has the largest market share for comprehensive hospital information systems in the US,(14) and has been adopted in many international settings as well.

Compelling Benefits

The primary benefits are cost reduction and interoperability by avoiding duplication of effort and following standards. Quality of generated information can improve if organizations use well-tested and validated components for systems development. Cloud computing (Software as a Service – SaaS model) provides significant cost savings.(32) The main savings are in the resources required to support ICT infrastructure; shared services have cost and workflow efficiencies when resources are reused across a virtual organization.(28)

Challenges, Barriers and Gaps

Challenges to building the global health infrastructure using standards-based reusable resources such as tools and services are threefold. First, basic computer science skills required to shift from the current model of siloed or isolated databases into distributed systems are limited. Second, there is a lack of policy and legal regulations in support of open access to information across the global context.(33) Finally, standardizing medical concept definitions is time consuming, making data inconsistent between systems and slowing the process of developing systems. (34)

Translating the benefits of reusable resources to resource-poor environments can be challenging. Reliable Internet access is rare in rural areas, though mobile phone networks are improving. Many projects need to manage local databases, though some are able to synchronize the data to a central server when connectivity is available. Electricity availability represents a challenge in many rural and even urban locations, but solar power, low-power devices and better batteries, and generators offer options to address outages.

Opportunities and Recommendations

Policy and governance development for the oversight of shared reusable resources is a global responsibility.(35) Certification for quality assurance may ensure high system quality and interoperability, leading to improved user satisfaction while easing data management burdens. Readiness assessments that measure economic and human capacity realities should be required. Assistance could be provided by a global community of practice to low-resource countries as required, to ensure that response and remediation to global health challenges are addressed quickly and efficiently. The next logical step is to make health informatics standards, especially those developed using public funds, available in the public domain. (Exhibit 6)

Exhibit 6: Summary of Globally Reusable Resources Track

Compelling Benefits

- Productivity is optimized and increased (reduced labor burden and cost efficiency).
- Implementing standards-based systems facilitates sharing of information, knowledge and infrastructure.
- Standardization and use of shared methods reduce duplication of effort.
- Open systems can be more effectively evaluated over time.
- Better decision making for sustainable health system operations and infrastructure.
- Standards-based design of tools provides greater flexibility while reducing costs.
- *Equal proactivity* is the notion that equity in tools and infrastructure increases global workforce capacity and efficiency.
- *Horizontalization of health systems* expands reach of health services.[a]

Challenges, Barriers and Gaps

- Data from legacy systems is generally not *machine-readable* and thus is not shareable seamlessly electronically among systems.
- Open access/public access: confusion (or ambiguity) exists about standards and legality of open access to data.
- Proprietary issues surround the customized code built out of collaborative efforts.
- Lack of skilled workforce required to build shared tools and reusable components.
- User interfaces are not standardized for medical information access, thus collaborative use requires considerable training, making it challenging for users to accept a new system.

Recommendations

- Ensure better policy development and governance for oversight of quality assurance and policy implementations.
- Clearly define the most important information gaps in global health.
- Support evidence-based evaluations of tools, services, and other reusable resources.
- Invest in robust infrastructures with scalable resources; build on sustainable solutions.
- Make health informatics standards available in the public domain.
- Encourage open source software development and implementation and suitable business models to ensure high quality standards, acceptable development time, and long-term support for maintenance.
- Promote sharing of medical content, including data dictionaries, coding standards and indicators among global stakeholders.
- Establish a worldwide mechanism for certification and testing of globally reusable services.
- Provide better methods for *findability* of shared products.
- Evaluate total cost of operation versus initial purchase price for FOSS projects and attempt to improve cost efficiency.

[a] Bacharach, S., "Technology Convergence, Market Horizontalization and, *Voila*: Information Fusion", Directions Magazine, http://www.directionsmag.com/articles/technology-convergence-market-horizontalization-and-ivoilai-information-fus/122770, 24 January 2008

Limitations

Due to limited funding for this activity, only participants of the 2011 Public Health Informatics Conference were able to attend the workshop. Thus, there was under-representation from many low-resource countries. An attempt was made to overcome this limitation by ensuring that the participants selected from the online registrants list brought a diverse experience of supporting the under-represented areas.

Discussion

Following the 2008 Meeting in Bellagio, Gerber et al identified the need for "an international public-private sector framework for understanding and moving forward on eHealth"(15). The 2011 global health workshop was an important step towards addressing this need and bridging a gap in the global health informatics domain. The workshop discussions created a rich environment to examine the evidence base and the participants' experience for the current status; compelling and potential benefits; challenges, barriers, and gaps; and recommendations for the key domains of informatics as applied to global health.

The strength of the workshop lay in the unique blend of participants who represented 15 countries and a diverse stakeholder landscape of governmental organizations, private sector companies, academia, and non-governmental organizations. In addition to their regular jobs, the participants provide voluntary support to various informatics and eHealth technical workgroups around the world and thus also represented those collaborative virtual organizations.

The participants recommended that effective policies and governance mechanisms must be in place prior to global crises response so that global health events do not overwhelm public health response capacity. The development of an infrastructure to support global health information exchange must address legal, technical, political and economic barriers. Establishment of priorities to guide economic investments in informatics research and innovation should support patient care, global health goals, public access to data and knowledge sharing among countries across both international and regional boundaries.

The health informatics community needs to collaboratively focus on addressing global health problems and challenges by leveraging existing infrastructure, harmonizing global policy and governance efforts, and advocating effectively.(36) For such a diverse community to coalesce and collaborate, appropriate resources must be acquired and allocated optimally to provide sustainable virtual and physical organizational support. Such a global community can drive rapid development of knowledge management mechanisms and systems that facilitate the identification of global health priorities; create, manage, share, and disseminate information; and facilitate decision making for evolving global health challenges, policies and events.

In resource-constrained environments, building informatics capacity allows for clinical delivery organizations and national Ministries of Health to continue to benefit from standards-based information management practices beyond the duration of externally-funded interventions or programs. When building informatics capacity, stakeholders must examine methods to train,

maintain and retain a workforce at the local level with skills to design, develop, implement and sustain the deployment of health information systems for eHealth initiatives.

Reusable ICT resources play a critical role in support of global health.(37) Primary drivers of adoption are economic because of reducing duplicate efforts; interoperability by building solutions on common technology standards;(38) developing partnerships with mutual benefits; pooling of experience and knowledge; and instituting a two-way information and knowledge flow between developed and developing countries. Low-threshold access to more resources than any single health system could afford individually can facilitate country participation in the global health information exchange projects while concurrently strengthening national infrastructure.(39)

Many countries have developed national eHealth strategies and initiatives to enhance the implementation of ICT in health. However, few have realized that developing eHealth national strategies while focusing only on the domestic needs has the potential to technically isolate their country from the rest of the world at times when there is need for relevant information sharing across borders. Examples of such use cases include reporting cases of public health emergencies of international concern by complying with the 2005 International Health Regulations (IHRs) (40), or when their residents visit other countries and health providers in the international location need to access the visitors' previous health information to provide care.(41) Following the informatics recommendations of standards-based implementation of eHealth will ensure that countries get prepared for participation in regional and global networks in support of use cases such as global health surveillance and global access to health care, with minimal additional effort required for each emerging event. The 2011 global health workshop recommendations pave the way for establishing an overarching global informatics strategy, following which will help countries stay technically synchronized with countries outside their borders. Because of the myriad of ongoing activities in the eHealth domain, individual countries would benefit from the informatics agenda for global health by acquiring guidance for developing and enhancing their individual and regional agendas.

Roadmap development activities on a global scale require commitment and funding support from global health funding organizations. The 2011 workshop was supported by limited funds from a few organizations; travel funds were not available for more key stakeholders to be included and thus the workshop lacked more global representation among the participants. Additionally, more funding would have enabled us to develop a longer and more comprehensive plan for the workshop. The large number of participants representing a diverse stakeholder group who acquired their organizations' support to attend the workshop clearly highlights the value of this activity. This report provides evidence that more investment in this domain is required. We anticipate that major global health donors will consider supporting the next phase of this activity.

In summary, the participants highlighted the importance of developing and implementing good informatics policy and governance guidelines in support of global health. They recognized the importance of global health stakeholders to focus on transparency, equity and technological interoperability as local needs change in response to domestic and global health events. To improve knowledge management and collaboration, stakeholders highlighted the need to explore methods for identifying, collating and sharing best practices, and for the adoption of social

networking technologies to foster rich collaborations. Local informatics workforce capacity development was recognized as a key foundation-stone for long term sustainability of eHealth initiatives. In the use and creation of health information resources, stakeholders must ensure that the products are adaptable, adoptable, and reusable by the global health community. Attention to these issues can lead to measurable improvements in health equity, individual health outcomes, and positive impact on global public health.

Conclusion

Global health informatics best-practices and principles continue to support global health systems via implementation of eHealth. The workshop provided a venue to examine the evidence base and the participants' experience to provide outcomes as summaries of the current status; compelling benefits; challenges, barriers, and gaps; and recommendations for the application of informatics scientific principles and best practices to support eHealth implementation for global health. We propose that these workshop findings be used as a foundation for the development of the full agenda and a detailed long-term roadmap for global health informatics activities. The global health informatics agenda and roadmap can potentially provide valuable guidance to countries for developing and enhancing their individual and regional agendas.

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Competing interests

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Disclaimer

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